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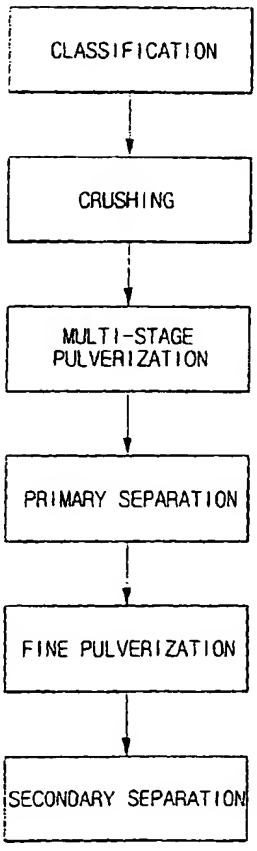

(57) Abstract: The present invention relates to a method of extracting pulverized plastic matter from waste printed circuit boards (PCBs), and materials for civil engineering and construction using the pulverized plastic matter. The method of extracting the pulverized plastic matter from the waste PCBs comprises the steps of classifying the waste PCBs by the material thereof with parts thereof removed; crushing the classified waste PCBs; pulverizing particles of the crushed waste PCBs in multiple stages to have particle sizes smaller than those of the particles of the crushed waste PCBs; primarily separating the multi-stage pulverized particles into metallic and plastic matters by the particle size thereof by using magnetic force and vibration; finely pulverizing the separated plastic matter to have a mean particle size ranging from 60¥im to 1 mm; and secondarily separating particles of the finely pulverized plastic matter into the metallic and plastic matters by the particle size thereof by using the vibration, specific gravity and the magnetic force.

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EXTRACTING PULVERIZED PLASTIC MATTER FROM WASTE PCB

Technical Field

The present invention relates to a method of extracting pulverized plastic matter from waste printed circuit boards (hereinafter, referred to as "PCBs"), and materials for civil engineering and construction using the pulverized plastic matter. More particularly, the present invention relates to a method of extracting pulverized plastic matter from waste PCBs, and materials for civil engineering and construction using the pulverized plastic matter, wherein the pulverized plastic matter extracted from the waste PCBs that are currently produced in large quantity is used as an additive for the materials for civil engineering and construction so that the materials can have superior physical properties.

Background Art

Recently, there is a growing tendency for the quantities of production and consumption of PCBs to be rapidly increased as various kinds of electronic products with the PCBs mounted therein, such as television sets and computers, are rapidly increased.

Therefore, since waste PCBs made during production of the PCBs or collected from discarded electronic products are rapidly increased, there are problems in that manpower and costs are largely wasted on incinerating or burying the waste PCBs and serious environmental pollution occurs.

Furthermore, since the waste PCBs, which have been made of relatively expensive materials with good quality, directly go into the discard, enormous waste of resources is produced.

Disclosure of Invention

The present invention is conceived to solve the above problems. An object of

the present invention is to provide a method of extracting pulverized plastic matter from waste PCBs, wherein a large quantity of the discarded waste PCBs are crushed and pulverized and then classified into metallic and plastic matters in order to extract the pulverized plastic matter to be used as an additive for construction materials.

Another object of the present invention is to provide a method of extracting pulverized plastic matter from waste PCBs, wherein pulverized granular plastic matter is chemically treated by passing through fish oil, or a coating remover, in order to enhance adhesive strength of the pulverized plastic matter with a binder for materials for civil engineering and construction.

A further object of the present invention is to provide materials for civil engineering and construction with superior physical properties using pulverized plastic matter extracted from waste PCBs, by binding a binder for the materials for civil engineering and construction with the pulverized plastic matter extracted from the waste PCBs.

According to a preferred aspect for achieving the objects of the present invention, there is provided a method of extracting pulverized plastic matter from waste PCBs, comprising the steps of classifying the waste PCBs by the material thereof with parts thereof removed; crushing the classified waste PCBs; pulverizing particles of the crushed waste PCBs in multiple stages to have particle sizes smaller than those of the particles of the crushed waste PCBs; primarily separating the multi-stage pulverized particles into metallic and plastic matters by the particle size thereof by using magnetic force and vibration; finely pulverizing the separated plastic matter to have a mean particle size ranging from 60 μm to 1 mm; and secondarily separating particles of the finely pulverized plastic matter into the metallic and plastic matters by the particle size thereof by using the vibration, specific gravity and the magnetic force.

According to another preferred aspect for achieving the objects of the present invention, there is provided a method of extracting pulverized plastic matter from waste PCBs, comprising the surface-treatment step of removing impurities on surfaces of the waste PCBs with parts thereof removed by immersing the waste PCBs in a mixed bath containing a mixture of 70 wt% water, 25 wt% caustic soda (sodium hydroxide), and 5

wt% dibutylacetylene for about 30 minutes at room temperature; the water-washing step of washing the surface-treated PCBs with water; the crushing step of crushing the washed PCBs to have proper sizes by using a hammer mill at a crush angle of 15 ~ 18 degrees; the pulverizing step of pulverizing particles of the crushed waste PCBs to form powder by using a ball mill; and the chemical treatment step of removing ink and an outer surface coating adhering to the pulverized powder.

According to a further preferred aspect for achieving the objects of the present invention, there is provided materials for civil engineering and construction using pulverized plastic matter extracted from waste PCBs, comprising the pulverized plastic matter extracted after pulverizing the waste PCBs; and a binder for materials for civil engineering and construction to be bound with the pulverized plastic matter.

Brief Description of Drawings

FIG. 1 is a flowchart showing a fundamental process for extracting pulverized plastic matter from waste PCBs according to the present invention.

FIG. 2 is a flowchart showing another process for extracting pulverized plastic matter from waste PCBs according to the present invention.

FIG. 3 is a flowchart showing a further process for extracting pulverized plastic matter from waste PCBs according to the present invention.

FIG. 4 is a sectional view showing the state where an airport runway or a roadway on a bridge's floor slab is paved with materials using the pulverized plastic materials extracted from the waste PCBs according to the present invention.

Best Mode for Carrying Out the Invention

Hereinafter, preferred embodiments of the present invention will be explained in detail with reference to the accompanying drawings.

FIG. 1 is a flowchart showing a fundamental process for extracting pulverized plastic matter from waste PCBs according to the present invention. The pulverized plastic matter for use in materials for civil engineering and construction can be extracted from the waste PCBs by using a method comprising the steps of removing parts

mounted on the waste PCBs; crushing the waste PCBs with the parts thereof removed; pulverizing particles of the crushed waste PCBs to have particle sizes smaller than a mean particle size of the particles of the crushed waste PCBs; forming powder by finely pulverizing particles of the pulverized waste PCBs to have a mean particle size ranging from 60 μm to 1 mm; and classifying the finely pulverized powder into metallic and plastic matters by the particle size and material thereof.

The pulverized plastic matter that has been extracted contains, as main components, denatured polyimide for forming the PCBs, thermosetting polyphenylene ether (PPE) based resin, epoxy, fiber glass wool, and the like. The pulverized plastic matter is bounded with a binder for materials for civil engineering and construction so as to impart superior properties thereto.

Further, the classified plastic powder having the size of 60 μm to 1 mm may be molded to have a predetermined size so that it can be used as an additive for the materials for civil engineering and construction.

FIG. 2 is a flowchart showing another process for extracting the pulverized plastic matter from the waste PCBs according to the present invention. The pulverized plastic matter for use in the materials for civil engineering and construction can be extracted from the waste PCBs by using a method comprising the surface-treatment step of removing impurities on surfaces of the waste PCBs with parts thereof removed by immersing them in a mixed bath containing a mixture of 70 wt% water, 25 wt% caustic soda (sodium hydroxide), and 5 wt% dibutylacetylene for about 30 minutes at room temperature; the water-washing step of washing the surface-treated PCBs with water; the crushing step of crushing the washed PCBs to have proper sizes by using a hammer mill at a crush angle of 15 ~ 18 degrees; the pulverizing step of pulverizing particles of the crushed waste PCBs to form powder by using a ball mill; and the chemical treatment step of removing ink and an outer surface coating adhering to the pulverized powder by passing it through fish oil that is a coating remover.

In the surface-treatment step, ink, various kinds of impurities and coatings on the surfaces of the waste PCBs with the parts thereof removed are removed therefrom so that only clean bodies of the waste PCBs can be processed. Upon completion of the

surface-treatment step, impurities still remaining on the surfaces are completely removed by washing the waste PCBs with water once again.

The waste PCBs from which the impurities have been completely removed are crushed to have particle sizes of 2 x 4 mm to 3 x 6 mm by means of the hammer mill at the crush angle of 15 ~ 18 degrees. The particles of the crushed waste PCBs are then pulverized to be granular powder by means of the ball mill.

The pulverized granular powder is chemically treated by passing through the fish oil, which is a coating remover, to remove metal adhering to the granular powder. Thus, only the pulverized plastic matter is extracted. The pulverized plastic matter that has been extracted is packaged and treated as such, so that it can be later used as an additive in the form of powder for the materials for civil engineering and construction.

FIG. 3 is a flowchart showing a further process for extracting the pulverized plastic matter from the waste PCBs according to the present invention. The process comprises the steps of classifying the waste PCBs by the material thereof with parts thereof removed; crushing the classified waste PCBs; pulverizing particles of the crushed waste PCBs in multiple stages to have particle sizes smaller than those of the particles of the crushed waste PCBs; primarily separating the multi-stage pulverized particles into metallic and plastic matters by the particle size thereof by using magnetic force and vibration; finely pulverizing the separated plastic matter to have a mean particle size ranging from 60 μm to 1 mm; and secondarily separating particles of the finely pulverized plastic matter into metallic and plastic matters by the particle size thereof by using the vibration, specific gravity and the magnetic force.

In a further process of extracting the pulverized plastic matter from the waste PCBs according to the present invention, the waste PCBs are collected, parts are removed from the collected waste PCBs, the waste PCBs with the parts thereof removed are classified by the material thereof, and then the classified waste PCBs are crushed to have particle sizes of about 8 ~ 15 cm.

Subsequently, particles of the crushed waste PCBs are pulverized in multiple stages to have particle sizes equal to or less than 8 mm, which are smaller than those of the particles of the crushed waste PCBs.

In the primarily separating step, the multi-stage pulverized particles are separated into the metallic and plastic matters by the particle size thereof by using the magnetic force and the vibration. The separated plastic matter is finely pulverized to produce particles in the form of powder having the mean particle size ranging from 60 μm to 1 mm. In the secondarily separating step, the particles of the finely pulverized plastic matter are separated again into the metallic and plastic matters by the particle size thereof by using the vibration, the specific gravity and the magnetic force. In such way, the extraction of the pulverized plastic matter from the waste PCBs is completed.

In the secondarily separating step, only valuable metal may be extracted from the metal matter that has been separated from the pulverized plastic matter. Thus, the extracted valuable metal can be recycled.

Moreover, in the primarily separating step, the pulverized plastic matter having a mean particle size of 1.1 mm to 5 mm is extracted and then used as an additive in the form of chips for the materials for civil engineering and construction. In the secondarily separating step, the pulverized plastic matter having a mean particle size of 60 μm to 1 mm is extracted and then used as an additive in the form of powder for the materials for civil engineering and construction.

The materials for civil engineering and construction using the pulverized plastic matter extracted from the waste PCBs were applied in various ways, and their physical properties were compared with one another in the following embodiments.

[First embodiment] – Case where the materials are applied to pavement of an airport runway or a roadway on a bridge's floor slab

Upon pavement of an airport runway or a roadway on a bridge' floor slab by using the pulverized plastic matter obtained through the above processes, a primer is coated on a footing concrete surface from which impurities have been removed. Subsequently, the pulverized plastic matter for the materials for civil engineering and construction is mixed with epoxy resin and then casting of the mixture is performed onto the primer-coated footing concrete surface.

At this time, if the construction is undertaken in an area where the severe cold

or heavy snow is expected, wire meshes may be optionally installed therein by employing a snow melting system prepared for the winter season.

Further, in a case where the strength adhering to the ground is weak, as shown in FIG. 4, anchors 5 are formed in the ground 10, and "+"-shaped or disk-shaped fixing plates 1 having openings 7 for bonding upper and lower portions are installed by using anchor bolts 3 that are inserted into and mounted in the anchors 5. Subsequently, the epoxy resin mixed with the pulverized plastic matter of the present invention is cast in the openings 7. When the epoxy resin is cured, first epoxy resin layers 2 with the pulverized plastic matter bound therewith are formed.

After the first epoxy resin layers 2 with the pulverized plastic matter bound therewith are formed, the epoxy resin mixed with the pulverized plastic matter is cast again to wrap the fixing plates 1. Thus, a second epoxy resin layer 6 with the pulverized plastic matter bound therewith is formed. Additionally, if a textured plate is cast onto the top of the second epoxy resin layer 6 with the pulverized plastic matter bound therewith to form a surface-treatment layer 8 for enhancing an appearance and friction force, more solid pavement of the airport runway or the roadway on the bridge's floor slab can be achieved.

Therefore, the pulverized plastic matter of the present invention can be used as the materials for civil engineering and construction of the airport runway, the bridge's floor slab, or the like.

In such way, for the application to the pavement of the airport runway or the roadway of the bridge's floor slab, as shown in Table 1, epoxy resin and resin mortar that have been bound with the pulverized plastic matter extracted from the waste PCBs, and epoxy resin and resin mortar that have not been bound with the pulverized plastic matter extracted from the waste PCBs were tested and compared with one another in view of their physical properties such as hardness, tensile strength, flexural strength, compressive strength, shear bond strength and pot life pursuant to a test method of the Korean Industrial Standards Mark (KSM). In addition, their viscosities were tested by using a Brookfield viscometer.

Table 1

Test items		Unit	Results of measurement				Test method
			For general use		Addition of the pulverized plastic matter extracted from waste PCBs		
			Epoxy resin	Resin mortar	Epoxy resin	Resin mortar	
Hardness		HDD	83	60	84	84	KSM3043-95
Tensile strength		kgf/mm^2	3.51	3.36	4.35	4.35	KSM3015-91
Flexural strength		kgf/mm^2	4.13	4.6	4.87	4.87	KSM3015-92
Compressive strength		kgf/mm^2	8.54	9.2	10.42	10.42	KSM3015-92
Shear bond strength		kgf/mm^2	0.82	1.03	1.07	1.07	KSM3732-91
Pot life		Hour	1	1	1	1	KSM5000-95
Viscosity (25℃)	Main material	cps	640	2100	2100	2100	Brookfield viscometer
	Curing agent	cps	275	111	111	111	

It can be seen from Table 1 above that the epoxy resin and resin mortar with the pulverized plastic matter added thereto are superior to the general epoxy resin and resin mortar to which the pulverized plastic matter has not been added, in view of the tensile, flexural and compressive strengths.

Therefore, the roadway of the bridge's floor slab or the airport runway paved with the epoxy resin and resin mortar with the pulverized plastic matter added thereto can have superior durability and thus prolonged life.

[Second embodiment] – Construction of a high-strength structure

Upon formation of a high-strength structure of a building, high-strength concrete or building materials should be employed. In this second embodiment of the present invention, the pulverized plastic matter extracted from the waste PCBs and the epoxy resin were mixed in a ratio of (2~3):1 so that they can be used for construction of the high-strength structure. After the structure of the building was constructed using the mixture of the pulverized plastic matter and the epoxy resin mixed as such, the physical properties of the structure was tested.

As a result, the high-strength structure containing the pulverized plastic matter of the present invention had the mechanical properties of the compressive strength of 900 kgf/cm^2 or more, the tensile strength of 450 kgf/cm^2 or more, and the flexural strength of 400 kgf/cm^2 or more. Thus, the structure having superior durability can be constructed in building works.

[Third embodiment] – Use for strength reinforcement of concrete and use for replacement of artificial silica sand or small-sized aggregate

Pulverized plastic matter corresponding to standards of 1 to 5 grades of silica sand or having a size of (2~3 mm) x (30~100 mm) in width and length among the pulverized plastic matter extracted from the waste PCBs of the present invention can be used for reinforcement of the strength of concrete and for replacement of artificial silica sand or fine aggregate.

In this third embodiment of the present invention, cement, sand, the pulverized plastic matter and gravel were mixed in a ratio of 1:1:1:3. The mixture was used for the reinforcement of the strength of the concrete and for the replacement of the artificial silica sand or fine aggregate.

The concrete mixed as such can solve the problem that it is conglomerated when mixed in the form of the existing glass wool. In addition, since the concrete is uniformly distributed, prevention of occurrence of cracks in a concrete structure and remarkable increase of the mechanical strength thereof can be achieved.

[Fourth embodiment] – Use of an extender or additive for a molded product

In this fourth embodiment of the present invention, powder of the pulverized plastic matter extracted from the waste PCBs was used as an additive or extender for a molded product such as polyvinyl chloride (PVC), paint, and materials for replacement of a road support or aluminum frame.

As shown in Table 2, PVC with the pulverized plastic matter added thereto and general PVC to which the pulverized plastic matter has not been added were tested and compared with each other in view of their physical properties pursuant to Japanese Industrial Standards (JIS).

As a result, a molded product fabricated by adding the pulverized plastic matter of the present invention as an additive or extender is superior to a general molded product (general PVC) to which the pulverized plastic matter has not been added, in view of the characteristics and properties of their powder. Particularly, the molded product fabricated according to the present invention has an excellent degree of polymerization to enable both adhesive strength in the molded product and durability of a finished product thereof to be enhanced.

Table 2

	General PVC	PVC with the pulverized plastic matter extracted from the waste PCBs added thereto	Test method
Degree of polymerization	1000 ± 50	1100 ± 50	JIS K-6721
K-value	64.5 ~ 66.7	66.7 ~ 68.5	
Apparent specific gravity (g/cc)	0.45 ~ 0.60	0.45 ~ 0.55	
Volatile component (%)	0.30 or less	0.30 or less	
Content of VacM (%)	-	-	
Granularity (%)	100 %	100 %	

[Fifth embodiment] – Use for replacement of artificial marble or a building panel

The pulverized matter generated according to the present invention and powder containing fiber glass as a main component were mixed in a proper ratio such as 1:1 or 1:2. Resin falling within an unsaturated polyester group is further added to the mixture in a ratio of 20 ~ 40 wt%. This mixture is then inputted into a mold having a shape suitable for its use, and subsequently molded therein for about 20 minutes at temperature of 180℃ under proper pressure (20 ~ 30 kgf/cm^2).

The molded product has advantages in that its strength is corrected by the fiber glass component and the pulverized matter of the PCBs and its weight is lower than that of the existing building panel or artificial marble so that when it is used as external ornament or interior decoration materials of a building, a structure constructed by the external ornament or interior decoration materials can be lightened and thus load of the structure can be relieved.

Further, color and characteristics according to the properties and states of the PCBs appeared on the external appearance of the molded product so that it was elegant and similar to natural marble. Alternatively, addition of stone powder or pigment resulted in products having various textures and colors.

[Sixth embodiment] – Use of the pulverized plastic matter as an additive for Ascon

In this sixth embodiment of the present invention, the pulverized plastic matter is mixed with coarse aggregate, fine aggregate, stone powder and asphalt and they are heated in a mixing vessel at mixing temperature of 160 ± 15℃ in order to produce Ascon.

In Table 3 below, general Ascon and Ascon with the pulverized plastic matter extracted from the waste PCBs added thereto were compared with each other in view of their physical properties.

Table 3

Test items		General Ascon	Ascon with the pulverized plastic matter extracted from the waste PCBs added thereto	Increased rate
Strain		0.1824	0.0065	Reduction by 30 times
Dynamic stability (times/mm)		230	6,550	Increase by 30 times
Toughness		21.86	34.96	Increase by 1.6 times
Ultimate tensile strength (kg/cm^2)		9.92	12.14	Increase by 1.2 times
Deflection upon destruction (mm)		3.28	3.28	-
Sliding resistance		52.2	61.8	Increase by 1.18 times
Recovery elastic modulus (Mpa)	20℃	3,757	4,090	Increase by 1.08 times
	40℃	622	871	Increase by 1.4 times

As shown in Table 3 above, the Ascon containing the pulverized matter of the waste PCBs had the reduced strain, high resistance against plastic deflection and occurrence of cracks resulting from excellent physical properties of the dynamic stability and tensile strength, and enhanced durability, as compared with those of the general Ascon. In addition, its strength was enhanced due to glass wool contained in the pulverized matter. Thus, the highly economical functional Ascon was obtained.

[Seventh embodiment] – Addition of the pulverized plastic matter to concrete, mortar and paint

In this seventh embodiment of the present invention, concrete, mortar and paint with the pulverized plastic matter added thereto and general concrete, mortar and paint to which the pulverized plastic matter has not been added were tested and compared with each other in view of their physical properties. The comparison results are shown in Tables 4 and 5 below.

Table 4

	Unit	General		Addition of the pulverized matter of the waste PCBs		Test method
		Concrete	Mortar	Concrete	Mortar	
Compressive strength	Kg/cm^2	229	250	238	310	KS L 5105
Tensile strength	Kg/cm^2	27	33	35	37	KS L 5104
Flexural strength	Kg/cm^2	42	68	53	75	ASTM C 384

Table 5

	General paint	Paint with the pulverized plastic matter extracted from the waste PCBs added thereto
Hardness	50 ± 5	70 ± 5
Tensile strength	30 ± 10	50 ± 10
Elongation (%)	700 ± 200	1000 ± 200
Cold resistance	-40℃	-40℃

It can be seen from the test results shown in Tables 4 and 5 above that mortar and paint, the concrete, mortar and paint containing the pulverized plastic matter of the present invention had superior hardness, tensile, flexural, and compressive strengths, and shear bond strength, as compared with the general concrete.

Therefore, it is possible to allow Ascon, concrete, epoxy resin mortar, paint and molded products to have superior properties by binding the pulverized plastic matter extracted from the waste PCBs of the present invention with a binder for materials for civil engineering and construction including epoxy resin, cement, sand and gravel, coarse aggregate, fine aggregate, stone powder, asphalt, etc.

Although the present invention has been described in connection with the specific embodiments, it is apparent to those skilled in the art that various modification and changes can be made thereto without departing from the technical spirit and scope of the present invention. These modification and changes fall within the scope defined by the appended claims.

Industrial Applicability

As described above, since the present invention recycles the waste PCBs, environmental pollution produced when incinerating or burying the waste PCBs can be prevented. Further, since materials for civil engineering and construction bound with the pulverized matter of the waste PCBs have superior properties, there is an advantage in that life of a structure constructed by means of civil engineering and construction works can be prolonged.

WHAT IS CLAIMED IS :

1. A method of extracting pulverized plastic matter from waste printed circuit boards (PCBs), comprising the steps of:

removing parts mounted on said waste PCBs;

crushing said waste PCBs with the parts removed;

pulverizing particles of said crushed waste PCBs to have particle sizes smaller than a mean particle size of said particles of said crushed waste PCBs;

forming powder by finely pulverizing particles of said pulverized waste PCBs to have a mean particle size ranging from 60 μm to 1 mm; and

separating said finely pulverized powder into metallic and plastic matters by the particle size and material thereof.

2. The method as claimed in claim 1, wherein after said step of separating said finely pulverized powder into said metallic and said plastic matters, said method further comprises the step of molding said separated plastic powder having a particle size of 60 μm to 1 mm to have a predetermined configuration and size.

3. The method as claimed in claim 1 or 2, wherein said plastic powder contains denatured polyimide, thermosetting polyphenylene ether (PPE) based resin, epoxy, and fiber glass wool.

4. A method of extracting pulverized plastic matter from waste PCBs, comprising the steps of:

classifying said waste PCBs by the material thereof with parts thereof removed;

crushing said classified waste PCBs;

pulverizing particles of said crushed waste PCBs in multiple stages to have particle sizes smaller than those of said particles of said crushed waste PCBs;

primarily separating said multi-stage pulverized particles into metallic and plastic matters by the particle size thereof by using magnetic force and vibration;

finely pulverizing said separated plastic matter to have a mean particle size ranging from 60 μm to 1 mm; and

secondarily separating particles of said finely pulverized plastic matter into said metallic and plastic matters by the particle size thereof by using said vibration, specific gravity and said magnetic force.

5. The method as claimed in claim 4, wherein said secondarily separating step further comprises the step of extracting valuable metal from said metallic matter separated from said plastic matter.

6. The method as claimed in claim 4, wherein said particles of said crushed waste PCBs have a mean particle size of 8 cm to 15 cm, and said multi-stage pulverized particles have particle sizes equal to or less than 8 mm.

7. The method as claimed in claim 4, wherein in order to use said pulverized plastic matter as an additive for materials for civil engineering and construction, said primarily separating step further comprises the step of extracting pulverized plastic matter having a mean particle size of 1.1 mm to 5 mm, and said secondarily separating step further comprises the step of extracting pulverized plastic matter having a mean particle size of 60 μm to 1 mm.

8. A method of extracting pulverized plastic matter from waste PCBs, comprising:

the surface-treatment step of removing impurities on surfaces of said waste PCBs with parts thereof removed by immersing them in a mixed bath containing a mixture of 70 wt% water, 25 wt% caustic soda (sodium hydroxide), and 5 wt% dibutylacetylene for about 30 minutes at room temperature;

the water-washing step of washing said surface-treated PCBs with water;

the crushing step of crushing said washed PCBs by using a hammer mill;

the pulverizing step of pulverizing particles of said crushed waste PCBs to form powder by using a ball mill; and

the chemical treatment step of removing ink and an outer surface coating adhering to said pulverized powder by passing it through fish oil that is a coating remover.

9. Materials for civil engineering and construction using pulverized plastic matter extracted from waste PCBs, comprising:

said pulverized plastic matter being extracted after pulverizing said waste PCBs; and

a binder for materials for civil engineering and construction to be bound with said pulverized plastic matter.

10. The materials as claimed in claim 9, wherein said pulverized plastic matter contains denatured polyimide, thermosetting polyphenylene ether (PPE) based resin, epoxy, and fiber glass wool.

11. The materials as claimed in claim 9, wherein said pulverized plastic matter has a mean particle size of 60 μm to 5 mm.

12. The materials as claimed in claim 9, wherein said binder for materials for civil engineering and construction comprises of epoxy resin.

13. The materials as claimed in claim 12, wherein said pulverized plastic matter and said epoxy resin are mixed in a ratio of (2~3):1.

14. The materials as claimed in claim 9, wherein said binder for materials for civil engineering and construction comprises of cement, sand, and gravel; and said pulverized plastic matter, said cement, said sand, and said gravel are bound with one another in a ratio of 1:1:1:3.

15. The materials as claimed in claim 9, wherein said binder for materials for civil

engineering and construction comprises of coarse aggregate, fine aggregate, stone powder, and asphalt; and said pulverized plastic matter, said coarse aggregate, said fine aggregate, said stone powder, and said asphalt are bound with one another by heating them at temperature of 160 ± 15℃.

16. The materials as claimed in claim 9, wherein said binder for materials for civil engineering and construction comprises of powder containing fiber glass as a main component; said pulverized plastic matter is mixed with said powder in a ratio of 1:1 or 1:2; resin falling within an unsaturated polyester group is further added to the mixture of said pulverized plastic matter and said powder in a ratio of 20 ~ 40 wt% of the total weight of said mixture; and this mixture is then molded.

Fig. 1

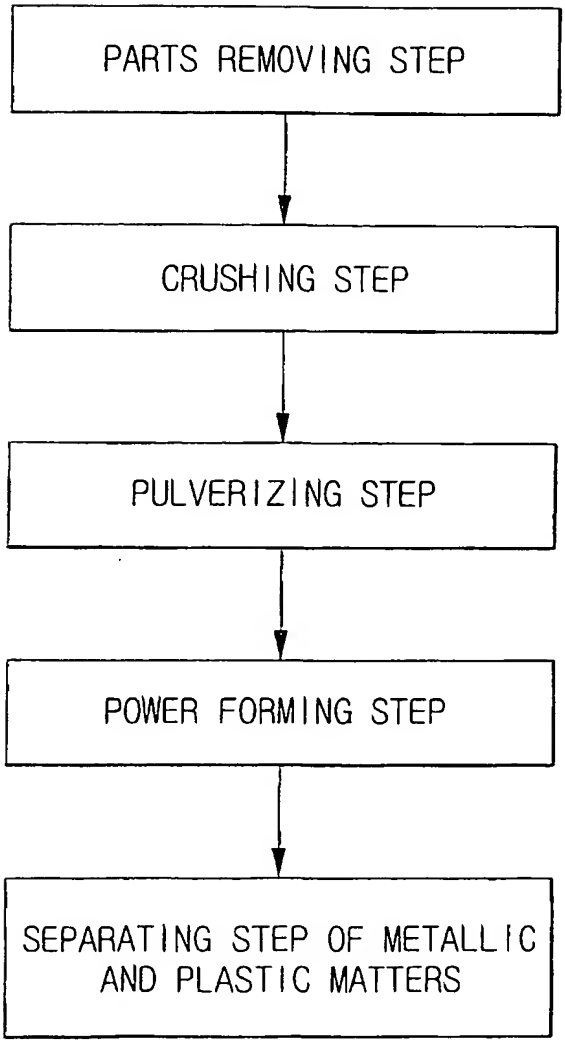

PARTS REMOVING STEP
CRUSHING STEP
PULVERIZING STEP
POWER FORMING STEP
SEPARATING STEP OF METALLIC AND PLASTIC MATTERS

Fig. 2

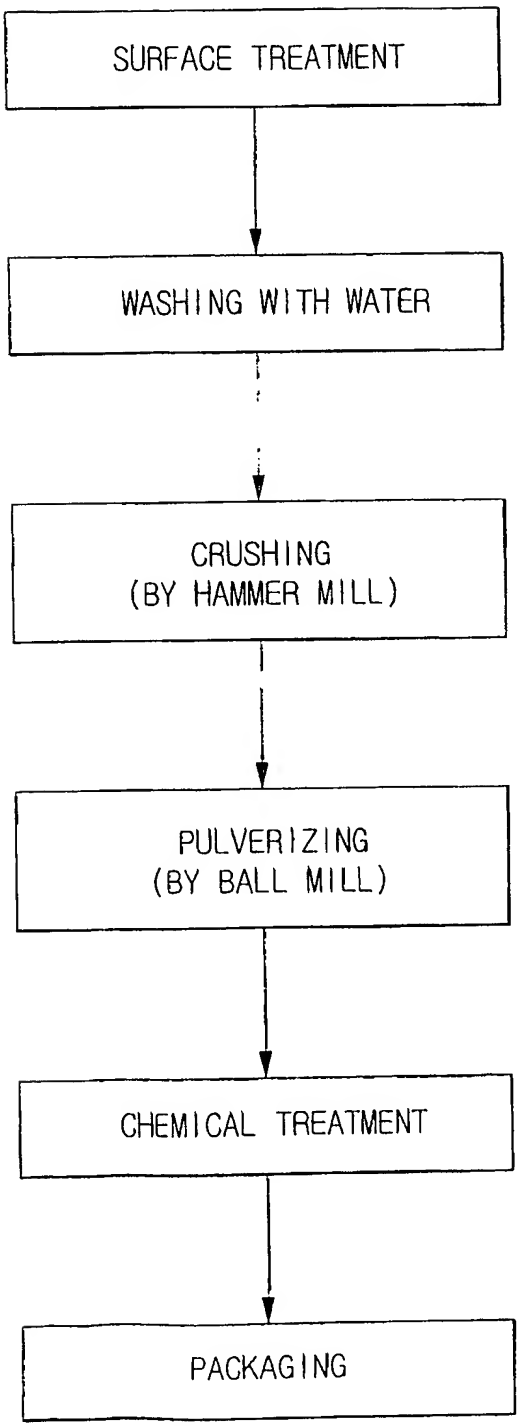

SURFACE TREATMENT
WASHING WITH WATER
CRUSHING
(BY HAMMER MILL)
PULVERIZING
(BY BALL MILL)
CHEMICAL TREATMENT
PACKAGING

Fig. 3

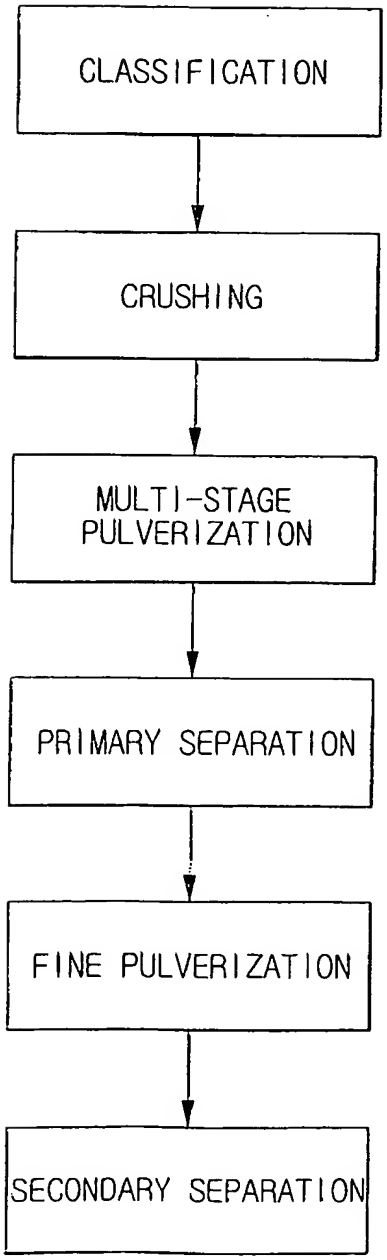
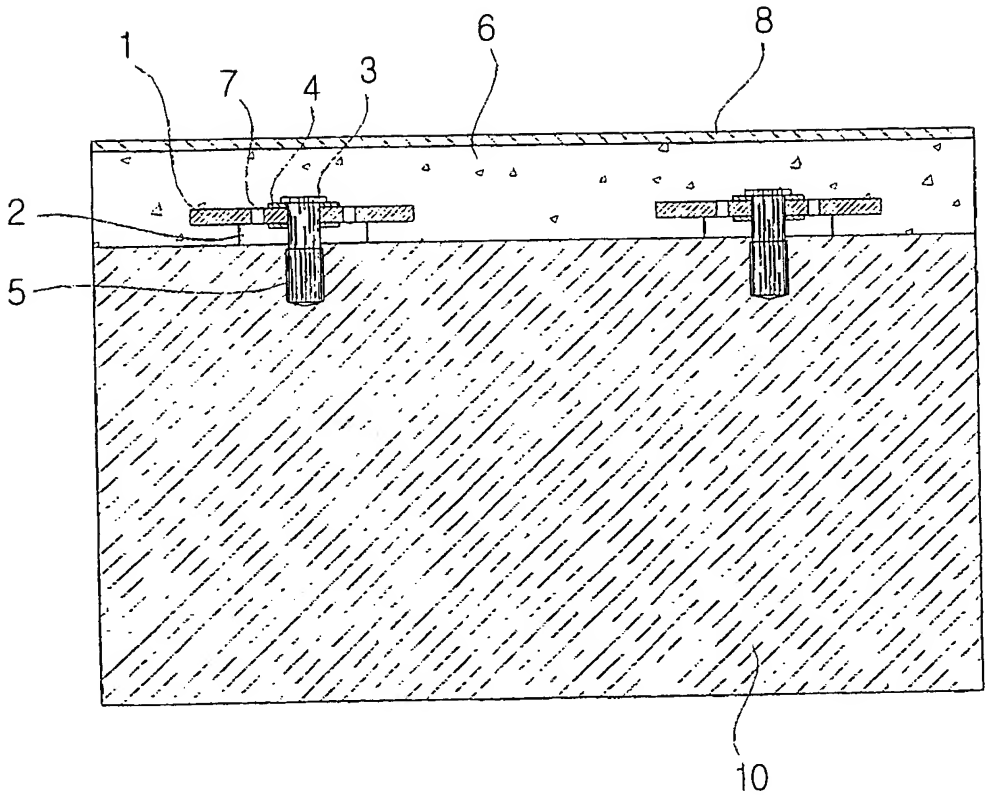

CLASSIFICATION
CRUSHING
MULTI-STAGE PULVERIZATION
PRIMARY SEPARATION
FINE PULVERIZATION
SECONDARY SEPARATION

Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 01/01714

CLASSIFICATION OF SUBJECT MATTER

IPC[7]: C08J 11/00, B09B 3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: C08J, B09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DEPATISNET, EPODOC, PAJ, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5676318A (YOKOYAMA et al.) 14 October 1997 (14.10.97) *claims, column 3, lines 29-46, column 6, lines 13-17, column 7, lines 3-7.*	1-7,9-13
X	JP 02 218486 A (SANKO KK) 31 August 1990 (31.08.90) (abstract) World Patent Index [online]. London, U.K.: Derwent Publications, Ltd. [retrieved on 2002-01-09]. Retrieved from: EPOQUE WPI Database. DW199041, Accession No. 1990-309001	1,4-7
X	JP 06 170276 A (DOWA MINING CO LTD) 21 June 1994 (21.06.94) (abstract). [online] [retrieved on 2002-01-09]. Retrieved from: EPOQUE PAJ Database.	1,4
X	DE 3937249 A1 (BASF AG) 16 May 1991 (16.05.91) *claims 1-3, column 1, lines 64-68.*	9-13,16

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 January 2002 (09.01.2002)	21 January 2002 (21.01.2002)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer WEIGERSTORFER Telephone No. 1/53424/221

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 01/01714

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 03 207483 A (KIYOYA NISHIMURA) 10 September 1991 (10.09.91) (abstract). [online] [retrieved on 2002-01-09]. Retrieved from: EPOQUE PAJ Database	9,14
X	SU 1758036 A1 (KHARK CAR ROAD INST) 30 August 1992 (30.08.92) (abstract) World Patent Index [online]. London, U.K.: Derwent Publications, Ltd. [retrieved on 2002-01-09]. Retrieved from: EPOQUE WPI Database. DW199334, Accession No. 1993-271345	9,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 01/01714

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
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JP	A2	2218486	31-08-1990			none	
JP	A2	3207483	10-09-1991			none	
JP	A2	6170276	21-06-1994			none	
SU	A1	1758036	30-08-1992			none	
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				JP	B2	2710206	10-02-1998
				JP	A2	7246382	26-09-1995